3 Economic Case

3.1 Introduction

3.1.1 The Economic Case within the Strategic Outline Business Case (SOBC) assesses proposals to identify all their impacts and their resulting value for money, in order to demonstrate whether a scheme or programme represents value for money.

3.1.2 In line with Treasury's appraisal requirements, the impacts considered are not limited to those directly impacting on the measured economy, nor to those which can be monetised. The economic, environmental, social and distributional impacts of a proposal are all examined, using qualitative, quantitative and monetised information. In assessing value for money, all of these are consolidated to determine the extent to which a proposal's benefits outweigh its costs.

3.1.3 The Economic Case for each corridor intervention under the '**Transforming Norwich**' programme for the Greater Norwich Region (GNR) will be demonstrated by an analysis of all its impacts and their associated value for money. DfT guidance on undertaking a SOBC requires that only initial findings on the associated value for money of a scheme are provided at this stage.

3.2 Scheme overview

3.2.1 The Economic Case assesses options to identify all their impacts, and the resulting value for money, to fulfil Treasury's requirements for appraisal and demonstrating value for money in the use of taxpayers' money. The Economic Case identifies what economic, environmental, social and distributional impacts the scheme is expected to have.

3.2.2 This section presents the Economic Case for the scheme and focuses on the monetised impacts of the scheme. The report sets out to provide:

- An assessment of the economic benefits of the '**Transforming Norwich**' programme capturing economic, environmental, social and distribution impacts of the scheme;
- An assessment of the scheme Value for Money (VfM) based on modelling of the impact on highways, public transport and active modes, as well as the monetisation of other scheme benefits where proportional to their impact, and the latest available scheme costs following current guidance on VfM.

3.3 Scheme objectives

3.3.1 The key objectives of '**Transforming Norwich**' are to:

- Improve people's productivity and social mobility by unlocking access to employment and education opportunities across the GNR;
- Increase the efficiency of travel and transport in the GNR and improve the impact transport has on carbon emissions, air quality and public health;
- Use emerging technology to prepare the GNR for a future of shared and clean mobility.

3.4 Approach to Economic Appraisal

Introduction

3.4.1 The economic appraisal has been carried out in line with Department for Transport (DfT) guidance to produce robust VfM assessments for the '**Transforming Norwich**' programme.

3.4.2 The Economic Case for the project concludes with a VfM assessment that incorporates both the monetised impacts and the non-monetised assessment of the project (including qualitative and non-monetised quantitative assessment where available).

3.5 Transport guidance

3.5.1 The HM Treasury (HMT) Green Book provides central government guidance on how to appraise and evaluate public policies, projects and programmes (the Five Case Model), which is based on the principles of welfare economics. The DfT Transport Appraisal Guidance (TAG) is the Department's internal guidance on business case making, with which the SOBC for this programme is consistent.

3.5.2 DfT's guidance on the economic appraisal requirement for TCF applications states that Economic Cases should include:

- "an appraisal of the economic impacts of the proposals, such as user benefits, but also encompassing evidence on wider impacts consistent with the principles of WebTAG, e.g. increasing access to employment through greater connectivity between workers in suburbs and city centre firms, unlocking housing, or how interventions could contribute to reducing deprivation or improving the urban realm;

- It is expected that not all impacts will be monetised at SOBC stage, especially for wider benefits ascribed to small schemes. A proportionate approach should be adopted, for example the use of supplementary economic modelling is not encouraged for an SOBC."

3.5.3 The guidance also states that the economic appraisal:

- Should ideally be assessed at a programme level, encompassing a package of smaller schemes;
- "Transport investment packages should be prepared for low, medium and high funding levels", indicating the requirement to set out a basis for prioritisation of individual projects within the overall investment package;
- The SOBC should be produced at a programme level, with the condition that each individual scheme constituting it does not exceed an investment value of £40m. For individual schemes over £40 million, business cases will also be expected to successfully progress through Outline Business Case (OBC) and Full Business Case (FBC) stages to be fully awarded funding.

3.5.4 The Economic Case for the scheme includes Cost-Benefit Analysis (CBA) of user and non-user impacts (from changes in travel costs and times, including decongestion) and changes in the externalities associated with car use (e.g. emissions and accidents). These, under an assumption of no changes in land use, are all termed Level 1 impacts. When set against a scheme's projected capital and operating expenditure, these result in an Initial Benefit-Cost Ratio (BCR). User benefits (in the form of monetised travel time savings) are typically the principal effect of a transport improvement and form the core of an economic appraisal but there is wide agreement that they fail to capture the full impact of major projects.

3.5.5 The DfT's latest guidance on wider economic impacts (published in May 2018) identifies three 'levels' of impact and these have been incorporated into the VfM assessment. These include:

- Level 1 (User benefits): These are direct effects and comprise the savings in time, vehicle operating costs and other elements of 'generalised travel cost' associated with better transport. The Level 1 BCR also includes some monetised externalities to society and the environment. These are also termed 'established' monetised economic impacts of transport investment (as they have long been the mainstay of economic appraisal);
- Level 2 (Productivity effects): these are productivity gains accruing to firms and workers, including those that are not themselves necessarily users of the transport improvement. These arise because of the economic benefits of scale and economic density, both of which are known to lead to higher productivity. These are also termed 'evolving' monetised economic impacts and are initially

(for Level 2) considered in terms of fixed land use scenarios, i.e. no interaction between transport supply and land use patterns;

- Level 3 (Investment and employment effects): these result from the potential for transport to alter patterns of private sector investment and employment, and thereby land use. This is a complex area of debate given transport links are but one factor shaping the location decisions for firms' investments. The concepts of additionality, displacement and the social value of investment are important here. These effects are also 'indicative' monetised impacts and can involve dynamic land use scenarios (in response to changes in transport supply).

3.5.6 Figure 40 sets out the relationship between the three levels of benefits.

Table 2 - Relationships between Wider Economic Impacts, Levels of Analysis and Land Use assumptions

	Level 1 (Initial BCR)	Level 2 (Adjusted BCR)	Level 3 (Indicative Monetised Impacts or Non-Monetised Impacts)
Fixed Land Use	User benefits →	→	→
		Static Clustering	→
Implicit Land Use Change		Output Change in Imperfectly Competitive Markets	→
		Labour Supply Impacts	→
Explicit Land Use Change			Dependent Development
			Move to More/Less Productive Jobs
			Dynamic Clustering
			Supplementary Economic Modelling

***Note that the arrows signify the previous levels of analysis are required**

Figure 40: Wider Economic Impacts

Source: DfT - TAG UNIT A2.1, Wider Economic Impacts Appraisal, May 2018

3.5.7 The scope of appraisal of these benefits is as follows:

- Level 1 benefits: Transport user benefits. We will assess the full range of transport user benefits including user travel time, vehicle operating cost, maintenance, accident, air quality, noise and greenhouse gases.
- Level 2 benefits: Wider Economic Impacts (WEI) (fixed land use). We will take a proportionate approach to the modelling of Level 2 benefits and will only look to assess the most important of these

benefits within the '**Transforming Norwich**' programme. This will entail the modelling of labour supply impacts where appropriate.

- Level 3 benefits: WEI (land use change). As above, we will take a proportionate approach to the modelling of Level 3 benefits and will only look to assess the most important of these benefits within the '**Transforming Norwich**' programme. This will entail the modelling of additionality and land value uplift where appropriate.

3.5.8 As such, the SOBC will present three core BCRs, including an:

- 'Initial BCR' – reflecting Level 1 benefits
- 'Adjusted BCR' – incorporating Level 2 benefits
- 'Total BCR' – incorporating Level 3 benefits that are net additional at the UK level

3.5.9 In addition, a 'BCR sensitivity test' will be carried out to demonstrate the total wider economic benefits arising from explicit land use changes at a Greater Norwich regional level. This will take into consideration the gross value of Level 3 benefits, rather than just the UK net additional value of Level 3 benefits used in the 'Total BCR'.

3.5.10 Level 2 and 3 WEIs and other social impacts would not normally be a focus at SOBC stage. However, TCF guidance explicitly references productivity and socio-economic impacts. Standard Level 1 benefits capture productivity impacts through segmentation of Employers' Business under the assumption of no distortions or market failures.

3.5.11 A standard approach at SOBC would be to set out the narrative, i.e. through logic mapping, as to how a particular scheme is expected to generate outputs, outcomes, and, ultimately, impacts (hopefully beneficial). At SOBC, depending on the focus of the scheme, this would typically mean a qualitative appraisal. However, the focus of '**Transforming Norwich**' and the magnitude of likely impacts may mean that initial WEIs analysis may be appropriate. This would be particularly true in the case of 'dependent development'. Nevertheless, analysis of these benefits would only be carried out if it was judged to be proportionate. This would mean that there would need to be sufficient belief that there would be significant dependent development in order to justify carrying out an assessment of its impact.

3.5.12 If analysis of local development has been undertaken it may be appropriate to estimate the quantum of development which would not proceed without the scheme. Principally this is a financial impact between the Do Something (DS) Scenario and the Do Minimum (DM) Scenario. Note that an LCR land use scenario builder has been developed for WYCA which combines local planning data and Regional Economic Model (REM) forecasts to produce MSOA level population and employment estimates.

3.6 Options assessed

3.6.1 Typically, a modelling approach is adopted in transport Business Case development which compares travel times across several user groups in a DM and DS scenario. Should the scheme(s) deliver a travel time saving in the DS scenario, this is monetised to derive transport user benefits, subject to the 'rule of a half' for new users.

3.6.2 For the purposes of estimating the transport user benefits of the '**Transforming Norwich**' programme, the interventions within Table 17 have been considered:

Table 17: Categories of intervention considered in the 'Transforming Norwich' programme

Category	Benefits quantified
Cycling and walking infrastructure	Wayfinding & pedestrian infrastructure improvements Segregated cycle track Improved cycle conditions
Improvements to the public transport network	Bus priority Contraflow lane Bus-only approach Bus lane Bus gate Access link/bridge Increased frequency on routes with journey time savings
Other shared and clean mobility	Implementation of zero emission zone High-occupancy vehicle lanes Car sharing Car Club
Digital connectivity and smart technology	Integrating ticketing Customer communication Smart city
Improved area-wide connectivity and accessibility	Mobility hub Demand Responsive Service Provision New capacity

3.6.3 A different approach will be used for each category, recognising the different impacts that they will have, and the need to maintain a proportionate approach. This is summarised in Table 18 below.

Table 18: Approach to traffic modelling and economic appraisal

Category	Modelling tool(s)	Benefits quantified
Cycling and walking infrastructure	DfT Active Mode Appraisal Toolkit	Journey ambience, physical activity (mortality and absenteeism), maintenance, accident, air quality, noise, greenhouse gases
Improvements to the public transport network	Spreadsheet, WebTAG marginal costs of congestion	User generalised time and fare, maintenance, accident, air quality, noise, greenhouse gases
Other shared and clean mobility	Norwich SATURN model, TUBA, WebTAG	User travel time, vehicle operating cost, maintenance, accident, air quality, noise, greenhouse gases
Improved area-wide connectivity and accessibility	Norwich SATURN model, TUBA, WebTAG	User travel time, vehicle operating cost, maintenance, accident, air quality, noise, greenhouse gases

3.7 Transport modelling

Highway modelling approach

3.7.1 Level 1 benefits represent transport user benefits and have been assessed using the Norwich Area Transportation Studies (NATS) SATURN model. This is an existing model covering Norwich and the surrounding area and has been previously accepted by the DfT as a suitable tool for the appraisal of other major schemes in Norwich, such as the Northern Distributor Road and Norwich Western Link.

3.7.2 The model was first developed in 2006 but has been subject to a number of updates since then, most notably in 2012 when the demand matrices were redeveloped, and more recently in 2017 and 2019 when the model was recalibrated for the purpose of assessing the A47 Road Investment Schemes and Norwich Western Link.

3.7.3 The model was originally developed as a multi-modal model with separate demand model and public transport assignment elements. However, these elements have not been updated since their development and are therefore not suitable to assess the public transport or active mode schemes within the '**Transforming Norwich**' programme.

3.7.4 The model network is focused on the city of Norwich but extends as far as King's Lynn, Downham Market and Thetford in the west, and to the coast in the east and north, including the coastal towns of Lowestoft and Great Yarmouth.

3.7.5 The model has a high level of network detail within the '**Transforming Norwich**' study area with all the main routes through the network represented in simulation. The network is sufficiently detailed to represent a majority of the proposed schemes which have highway impacts. The network is sufficiently detailed to represent a majority of the '**Transforming Norwich**' schemes which have highway impacts.

3.7.6 The model represents AM and PM peak hours (08.00-09.00 and 17.00-18.00 respectively). Inter-peak and off-peak hours have not been modelled for the '**Transforming Norwich**' assessment, however it is expected that the main highway network impacts would occur in the peak periods when the network is busiest.

3.7.7 Further detail about the NATS highway model and its suitability for the '**Transforming Norwich**' assessment is provided within Appendix 3 (Highway Modelling Technical Note 1 – Base Model Review).

Park & Ride Modelling

3.7.8 The SATURN model has, therefore, been used to estimate the potential mode shift to Park & Ride as a result of increasing generalised cost in the highway network. Where bus priority measures proposed in the '**Transforming Norwich**' programme fall on the Park & Ride routes and would benefit Park & Ride buses, the estimated bus journey time savings have been included within the SATURN model within the DS scenario. In addition, proposed schemes to improve the Park & Ride network (e.g. expansion of the Thickthorn site) are represented in the SATURN model where possible. Therefore, the decongestion effects of shift from car to Park & Ride are automatically captured within SATURN and do not need to be estimated separately as part of the wider public transport modelling set out below.

3.7.9 The NATS SATURN model includes a representation of the Park & Ride routes in Norwich and is able to assign traffic to these routes as an alternative for travel into the city centre. This methodology is set out as a proportionate approach for assessing park and ride within an assignment model in WebTAG Unit M5.1.

3.7.10 The SATURN model has therefore been used to estimate the potential mode shift to Park & Ride as a result of increasing generalised cost in the highway network. Where bus priority measures proposed in the TCF packages fall on the Park & Ride routes and would benefit P&R buses, the estimated bus journey time savings have been included within the SATURN model within the DS scenario. In addition, some of the TCF schemes to improve the Park & Ride network (e.g. expansion of the Thickthorn site) are represented in the SATURN model. Therefore, the decongestion effects of shift from car to Park & Ride are automatically captured within SATURN and do not need to be estimated separately as part of the wider public transport modelling work stream.

3.7.11 Further detail about how the Park & Ride has been modelled in SATURN is included in Appendix 4 (Highway Modelling Technical Note 2).

Highway Model Forecasts

3.7.12 A DM future year scenario has been developed for future years of 2023 and 2038, the former reflecting the anticipated delivery year of the TCF proposals. The model network was updated to include other recently built or committed schemes within the city, as discussed and agreed with NCC.

3.7.13 Key development sites are point loaded in the model and background growth from TEMPRO has been added, adjusted to reflect the future years modelled. The overall level of growth modelled is constrained to NTEM growth forecasts for Norwich.

Schemes Assessed with Highway Model

3.7.14 Measures within the ‘**Transforming Norwich**’ programme which affect the highway network have been represented in the model within a DS scenario.

3.7.15 Schemes which improve the Park & Ride network have been modelled in SATURN where possible. For example, the proposed expansion of the Thickthorn site is represented but more general measures such as the relaunch and rebrand of the Park & Ride service are not.

3.7.16 Further detail about the TCF schemes modelled and how they are represented is included within Appendix 4 (Highway Modelling Technical Note 2 – Forecasting).

TUBA Methodology (Highway User Impacts)

3.7.17 DfT's TUBA software has been used to calculate travel time and vehicle operating cost impacts on road users. The appraisal reflects a 60-year period from an opening year of 2023.

3.7.18 The appraisal used the most recent available version of TUBA (1.9.13) and therefore includes the most recent economic parameter values from WebTAG.

3.7.19 The modelled hours have been annualised based on factors derived from traffic count data at three sites within the city. These sites are located on key corridors and are considered to be a representative traffic flow profile to use for annualising peak hour benefits.

3.7.20 The appraisal results have been checked extensively by examining vehicle weighted delay changes within the SATURN model.

3.7.21 Further information about the economic appraisal of highway user impacts, including narrative on model delay increases, is included within Appendix 5 (Highway Modelling Technical Note 3 – Economic Appraisal).

Marginal External Costs

3.7.22 The WebTAG Marginal External Cost (MEC) methodology[10] has been adopted to estimate the approximate level of economic benefit for a number of impacts that would typically be fully assessed and monetised at later stages of appraisal. These include maintenance impacts, accident savings, air quality and noise impacts. The MEC methodology applies economic benefits based on a change in (annualised) vehicle kilometres. The SATURN model has been used to provide inputs to this assessment based on the changes in vehicle kilometres in the network between the DM and DS scenarios.

3.7.23 Further information about the MEC assessment of highway user impacts is included within Appendix 5 (Highway Modelling Technical Note 3 – Economic Appraisal).

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[10] https://www.gov.uk/government/publications/webtag-tag-unit-a5-4-marginal-external-costs-may-2018

3.8 Bus Modelling Methodology

Overview of approach

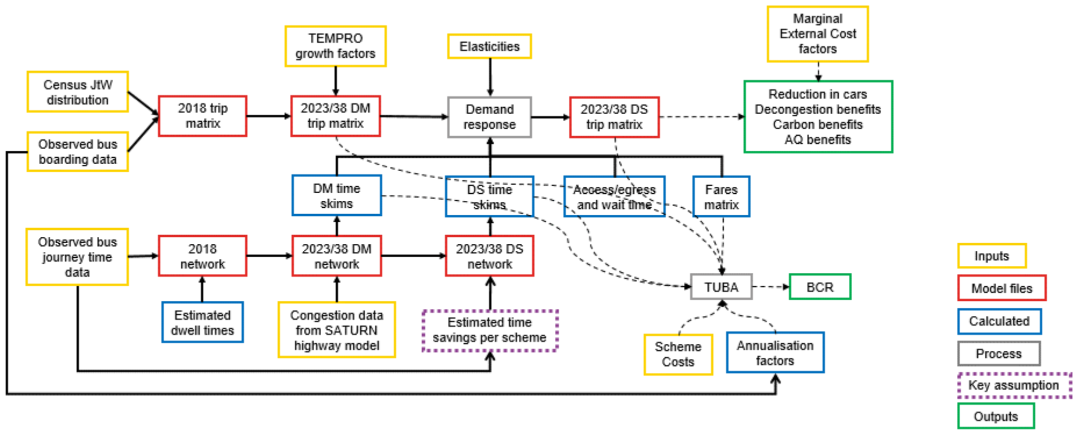
3.8.1 The approach taken to estimate Level 1 bus benefits can be summarised as follows, and is illustrated in Figure 41:

- Developed a base year matrix of bus trips using observed boarding data and Census Journey to Work data to distribute the trips;
- Developed a base year bus network in SATURN, with nodes and zones representing each bus stop and links representing bus stop pairs;
- Produced a base year fare matrix;
- Produced future year (2023/38) DM matrices and networks, using:
- growth factors from the National Trip End Model (NTEM) to represent background growth in bus trips;
- journey time factors derived from the Norwich SATURN highway model to reflect changes in congestion;
- real growth in fares from DfT Statistics Local Bus Fares Index;
- Estimated the journey time savings for each bus-based intervention (using the difference between peak and off-peak journey time as a measure of the delay) and produced a DS network;
- Estimated wait time savings due to increased bus frequencies;
- Applied standard elasticity values to estimate the change in the demand and produced a DS matrix;
- Calculated user benefits and operator revenue benefits using TUBA;
- Calculated quality benefits for upgraded bus stops and mobility hub interchanges using TAG databook values run through TUBA;
- Calculated the reduction in car-kms and walk/cycle trips using bus diversion factors, and used Marginal External Cost (MEC) factors to calculate additional decongestion, maintenance, accident, air quality, noise and greenhouse gas benefits.

3.8.2 Secondary mode-shift impacts taking account of the push from car to bus due to highway changes, and the pull from bus to walk/cycle due to walk/improvements, were captured in a sensitivity test.

3.8.3 In addition, outputs from the model were used to estimate Level 2 benefits and to undertake a more in-depth environmental assessment.

3.8.4 Further details on the approach taken to estimate Level 1 bus benefits are provided in the rest of this chapter.



Source: Mott MacDonald

Figure 41: Overview of bus modelling methodology

Bus data

Observed bus data

3.8.5 The observed bus data was provided by Prospective who were contracted by First Bus to assist them in data analysis. It only contained data from First Bus taken from GPS devices on each bus. The data contained average travel time between bus stop pairs for weekdays, Saturdays and Sundays in September 2018. It was provided for each bus route and in hourly intervals.

3.8.6 The travel time is the time taken between bus stop pairs. This does not include the dwell times.

3.8.7 Data for the number of boardings per bus stop by route and time interval, for weekdays, Saturdays and Sundays from August 2018 to July 2019 was also provided.

Base model development

Network and zones

3.8.8 The network was created as a buffer SATURN network with nodes representing each bus stop and one-way links representing bus stop pairs. Link times were based on the travel time data provided by Prospective. The modelled time periods are shown in Table 19.

Table 19: Model Time Periods

Time Period	Modelled hours
AM peak hour	08:00-09:00
IP average hour	10:00-16:00 (average hour)
PM peak hour	17:00-18:00

3.8.9 The dwell times were calculated as a linear function of the number of boarding passengers: a 4 second constant plus 1.5 seconds per boarder. This was based on a number of papers found online[11]. The dwell times were added to the travel time on each link.

3.8.10 Some bus stops are not served in all the time periods. In these instances, a speed of 32km/h was assumed, which is the average speed for the rest of the bus stops pairs. This was assumed in order to have a matrix of the same dimensions for each time period.

3.8.11 In the data received from Prospective it was observed that there were some bus stop pairs that had a travel time of zero seconds. The same assumption of 32km/h was made in this case.

3.8.12 Each node represents a bus stop and every node is connected to a single zone (1:1 relationship) that also represent the bus stop. In total there are 1294 zones in the model.

Demand

3.8.13 The Base trip matrix of bus passengers was created by combining the distribution from the 2011 Census Journey to Work data with the trip ends from the Prospective boarding data.

3.8.14 The Journey to Work data provided a production-attraction matrix of bus trips based on the home and workplace of the employed population. The average proportion of bus trips taken was calculated based on home/workplace at the MSOA level.

3.8.15 This Census distribution was assumed to represent morning commute trips, i.e. the AM peak. The PM peak distribution was assumed to be the transpose of the AM. The Inter-peak distribution was assumed to be the average of the AM and PM.

3.8.16 The locations for each bus stop was mapped to its MSOA, and the distribution was split for each bus stop pair. The distribution was spread evenly across all the bus stop destinations within that MSOA, and then normalised to a proportion.

[11] https://pdfs.semanticscholar.org/1e4c/86f2506f39646a6654e27f8a4a2a6d7d3af0.pdf

3.8.17 The total number of boardings by stop and time period was calculated from the Prospective boarding data. Only average September 2018 weekdays were considered.

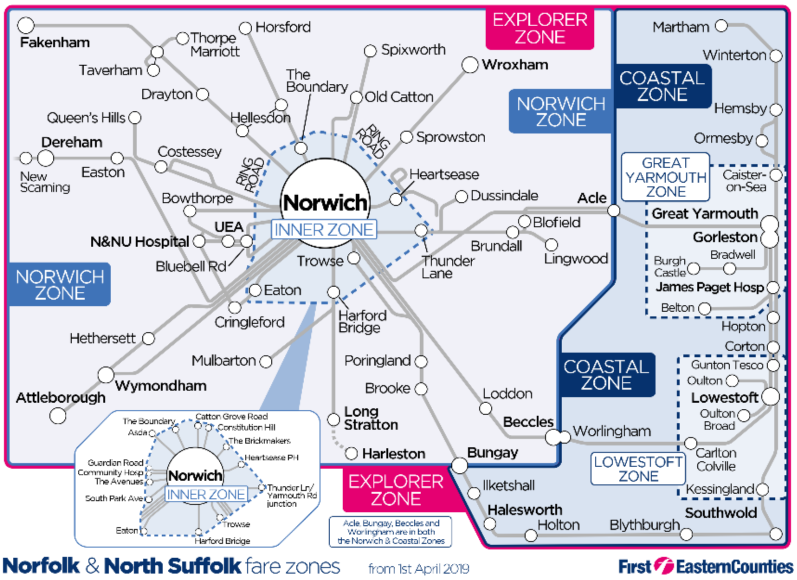
3.8.18 The Census-derived distributions were applied to the boarding data trip ends to form Base matrices of bus passenger trips.

3.8.19 The magnitude of the Base demand was validated by First Bus.

Fares

3.8.20 Fare matrices were produced to provide generalised costs for demand elasticity response and for TUBA.

3.8.21 First Bus use a fare system (see Figure 42) with 84 unique ticket types, not including National Concession Pass ticket types which are free (except before 09:30 on weekdays). Tickets types include, purchase prior to boarding, or on the bus, which zones travel is between, and whether the person is an adult, National Concession Pass holder, student or Young Person.



Source: https://www.firstgroup.com/uploads/node_images/norfolk-suffolk/FEC-ZN-Norfolk%26NorthSuffolkZonesMap03-19v2.pdf

Figure 42: Zone system of First Bus Network around Norwich

3.8.22 Unique fares were consolidated into 3 values, depending on which zone the origin and destination of the journey are located. The following assumptions (Table 20) were used in the consolidation process.

Table 20: Assumptions used in consolidating fares

Assumptions
First Bus fares only considered
Any bus stop in network outside of explorer zone classed as explorer fare
National Concession Pass holder / Senior tickets are free
Students classed as Young Person
Assumed 2 trips a day (outbound and inbound)
Assumed 50:50 split of tickets bought prior to boarding and on bus
For annual student tickets, assumed 39 weeks in a year
Assumed that Daily, Monthly, Termly, Annual tickets are split equally
Tickets by age groups:
DfT bus statistics data provided proportion of senior tickets (Norfolk County)
West Midlands data to get Ratio of Adult to Young Person passengers

3.8.23 Weighting for passenger types was produced by obtaining the proportion of concessions tickets sold in the Norfolk area using the National Travel Survey – Table BUS0823 - Concessionary Trips and Table BUS0109 – Passenger Journeys. In the absence of breakdown of tickets sold for adults and children, the remaining portion was split using passenger proportions from Transport for West Midlands[12] statistics (Table 21).

Table 21: Norfolk bus passenger types (assumed)

	Child 0-19	Adult 20-59	Senior 60+
Norfolk Passenger Proportion	7.7 %	58.7 %	33.6 %

3.8.24 Applying passenger type weightings to the average in each zone, the following weighted average prices were produced (Table 22).

Table 22: Weighted average prices for zone travel in 2019 values, 2019 prices

Zone	2019 Values, 2019 Prices
Inner Zone	£1.15
Norwich Zone	£1.21
Explorer Zone	£2.07

Do-Minimum model

Background changes to bus travel times

3.8.25 Travel time factors were applied to the network to represent increases in congestion in future years. The factors were calculated using congested link

[12] https://www.tfwm.org.uk/media/2376/travel-trends-web.pdf

time data extracted from the SATURN highway networks per time period, corridor and direction.

3.8.26 The base (2015) and forecast year (2023, 2038) DS Saturn highway were used to calculate the travel time growth factors. To get the times for the base year 2018, the travel times from the years 2015 and 2023 were interpolated.

3.8.27 Travel time factors (Table 23) were applied to the links that belonged in the corridors and to the IVT element only, not to the dwell time. Dwell time was assumed to stay the same as the base year.

3.8.28 There was no SATURN model available for IP. Therefore, IP factors were calculated as half of the average of the growth between the AM and PM periods.

Table 23: Travel time factors for years 2023 and 2038

		2018 to 2023		2018 to 2038	
Time Period	Corridor	Inbound	Outbound	Inbound	Outbound
AM	Airport	1.026	1.006	1.103	1.013
	Broadland	1.116	1.008	1.171	1.146
	City Centre	1.102	1.052	1.162	1.073
	Easton	1.108	1.098	1.373	1.284
	Rackheath	1.170	1.144	1.275	1.172
	Sprowston	1.013	1.005	1.043	1.015
	Wymondham	1.032	1.018	1.146	1.057
PM	Airport	1.010	1.052	1.044	1.237
	Broadland	1.051	0.976	1.233	1.121
	City Centre	1.025	1.043	1.166	1.076
	Easton	1.137	1.060	1.164	1.234
	Rackheath	1.151	1.168	1.182	1.268
	Sprowston	1.013	1.007	1.026	1.047
	Wymondham	1.049	1.088	1.140	1.158
IP	Airport	1.009	1.015	1.037	1.062
	Broadland	1.042	0.996	1.101	1.067
	City Centre	1.032	1.024	1.082	1.037
	Easton	1.061	1.039	1.134	1.129
	Rackheath	1.080	1.078	1.114	1.110
	Sprowston	1.007	1.003	1.017	1.015
	Wymondham	1.020	1.026	1.071	1.054

Background growth in bus trips

3.8.29 First Bus reported a 6% increase per annum of bus passengers year on year in Norwich. A similar uplift was recorded for 2018/19 and 2017/18. However, this level of growth has not been seen in previous years and was considered too high to extrapolate forward as a long-term trend.

3.8.30 Instead, the National Trip End Model (NTEM) forecasts were used to derive background growth. An Average Weekday for Bus/Coach in 2023 and 2038 was considered for the districts surrounding Norwich: Breckland, Broadland, North Norfolk, Norwich, and South Norfolk.

3.8.31 A flat growth factor was applied across the whole network (with the exception of the area covered by Cross Valley Link - see below) from 2018 to each Forecast Year. The factors used are in Table 24.

Table 24: NTEM Background Growth of Bus Passengers

Forecast Year	% Increase from 2018
2023	2.3%
2038	9.0%

3.8.32 The growth of the area covered by the Cross Valley Link (CVL) scheme, including the University of East Anglia (UEA), Norfolk and Norwich University Hospital (NNUH) and Norwich Research Park (NRP) was enhanced separately to be consistent with a separate more detailed assessment of this scheme. The forecast growth for these zones was significantly higher than the NTEM background growth due to planned developments in the area.

3.8.33 The factors used were derived from the modelling work done by AECOM on the CVL scheme and are presented in Table 25. Only the AM and PM peaks were modelled, so the IP growth was enhanced by an average of the AM and PM factors.

Table 25: Cross Valley Link Background Growth of Bus Passengers

	% Increase from 2018 to 2023				% Increase from 2018 to 2038			
	AM		PM		AM		PM	
Location	Out	In	Out	In	Out	In	Out	In
UEA	6%	6%	6%	6%	23%	23%	23%	23%
NNUH	21%	21%	21%	21%	84%	84%	84%	84%
NRP	48%	77%	69%	69%	192%	308%	278%	277%

Growth in fares

3.8.34 The fare values were uplifted (Table 26) to modelled years 2023 and 2038 using a real increase in bus fares of 1.87% per year (*DfT Statistics, Table BUS0405b, Local Bus Fares Index*). Values were also converted into seconds using value of time statistics (TAG Table A1.3.2 - Forecast values of time per person) and passenger purpose tables (National Travel Survey – Table NTS0409a - Average number of trips by purpose and main mode).

Table 26: Growth in Fares in pounds and seconds. 2019 prices

Zone	2019 Values		2023 Values		2038 Values	
	£	secs	£	secs	£	secs
Inner Zone	1.15	679	1.24	696	1.57	673
Norwich Zone	1.21	711	1.30	729	1.64	706
Explorer Zone	2.07	1213	2.22	1244	2.80	1203

Do-Something model

Journey time saving assumptions

3.8.35 Where possible, journey time savings for each bus intervention were estimated and coded into the SATURN network to produce DS networks. These savings were validated by asking those with local knowledge and experience in estimating bus delays.

3.8.36 The observed bus journey time data was used to estimate the delay for each bus stop pair by calculating the difference between each modelled hour and the average off-peak hour. The bus stop pairs that would be impacted by each intervention were identified, and an assumption was made that the bus lane and bus priority interventions would remove 80% of the delay for those bus stop pairs.

3.8.37 For schemes that fell outside this category, the following methodologies and assumptions were applied:

- For Scheme ID 1 ‘Castle Meadow bus stop capacity’ an assumption was made, through discussion with First Bus in Norwich, that the improvements to the layout of the bus stops would remove 20 seconds of delay per bus in the AM and PM peaks, and 5 seconds of delay per bus in the inter-peak. These values are in the middle of the range estimated by First Bus.
- For Scheme ID 19 ‘Cross Valley Link’ the journey time saving assumptions were obtained from AECOM who have undertaken a separate, more detailed, study of this scheme. Our savings for this scheme were calibrated against this study by taking percentage time savings from AECOM’s assessment for Option 1 of the scheme, and applying them to the DM journey times. Values for AM and PM were provided, and an average of the AM and PM was assumed for all time periods. Table 27 presents the percentage time savings relative to the DM.

Table 27: Cross Valley Link journey time reduction (relative to the Do-Minimum)

	AM	IP (average of AM and PM)	PM
NNUH to UEA (inbound)	-41%	-41%	-41%
UEA to NNUH (outbound)	-62%	-56%	-50%

- For Scheme ID 24 ‘Enable one-way traffic circulation along Denmark Road, Magdalen Road and Sprowston Road’ the average OP speed was calculated for the existing Sprowston Road section, and applied to the new circulatory route to calculate a new journey time for the AM, IP and PM.
- For Scheme ID 59 ‘Yarmouth Road - contraflow between Clarence Road and Carrow Road’ the delay was removed using the standard method, with an additional journey time saving applied to reflect the shorter distance.

3.8.38 The time savings were estimated separately by time period as greater time savings are expected in the peak hours.

3.8.39 As the level of congestion rises in future years, the potential journey time savings are expected to increase. This was reflected in the appraisal by factoring up the journey time savings per scheme before inputting to the DS SATURN network, using the background changes to bus speeds.

3.8.40 Table 28 presents the estimated time savings per scheme per passenger.

Table 28: Time savings per scheme for 2023 and 2038 (seconds per passenger)

ID	Scheme	Inbound / Outbound	2023			2038		
			AM	IP	PM	AM	IP	PM
1	St Stephen's Street / Red Lion Street / Castle Meadow bus stop capacity	Inbound / Outbound	-20.6	-5.1	-20.6	-21.3	-5.4	-21.8
8	Chapel Field North / East traffic changes	Outbound	-46.3	-36.3	-96.3	-48.3	-37.7	-102.3
10/MH 1	Foundry Bridge junction and Norwich station mobility hub	Inbound	-31.0	-25.0	-40.0	-34.0	-26.0	-46.0
19	Cross Valley Link	Inbound	-260.5	-239.5	-242.0	-263.5	-241.0	-244.5
		Outbound	-223.0	-239.5	-225.0	-223.0	-239.5	-225.0
21/MH 9	Newmarket Road (Eaton Road - Christchurch Road) Inc Mobility Hub	Inbound	-40.0	-8.0	-11.0	-44.0	-8.0	-12.0
		Outbound	-26.0	-17.0	-52.0	-27.0	-18.0	-57.0
24	Wroxham Road - Denmark Hill area	Inbound	-28.0	-14.0	-22.0	-29.0	-14.0	-24.0
		Outbound	-14.0	-7.0	-18.0	-13.0	-8.0	-19.0
25	Wroxham Road – n/b bus lane to ORR scheme	Inbound	-50.0	-2.0	-18.0	-52.0	-2.0	-19.0
26	Sprowston Road – Shipfield to ORR	Outbound	-1.0	-4.0	-6.0	-2.0	-4.0	-6.0
35	Dereham Road / Longwater Lane	Inbound	-38.0	-3.0	-7.0	-46.0	-3.0	-7.0
		Outbound	-13.0	-15.5	-41.0	-15.0	-16.5	-48.5
37/MH 17	Dereham Road / Breckland Road Inc Mobility Hub	Inbound	-18.0	-15.0	-16.0	-23.0	-16.0	-16.0
		Outbound	-8.0	-2.0	-23.0	-11.0	-3.0	-27.0
40/MH	Dereham Road outbound approach to Larkman Lane Inc mobility Hub	Outbound	-6.0	-2.0	-28.0	-7.0	-1.0	-33.0
43	Dereham Road / Old Palace Road / Heigham Road	Inbound	-15.0	-11.0	-6.0	-19.0	-11.0	-6.0
		Outbound	-35.0	-33.0	-64.0	-41.0	-36.0	-75.0
44	Dereham Road inbound approach to Grapes Hill	Inbound	-10.0	-6.0	-4.5	-10.0	-7.0	-5.5
45	Kett's Hill roundabout	Inbound	-38.0	0.0	-4.0	-40.0	0.0	-5.0
46	Heartsease 5 ways roundabout	Inbound	-24.0	-11.0	-13.0	-25.0	-12.0	-13.0
		Outbound	-4.0	-10.0	-76.0	-3.0	-10.0	-81.0
59	Yarmouth Road – contraflow between Clarence Road and Carrow Road	Inbound	-37.0	-32.0	-21.0	-38.0	-33.0	-22.0
61	Thorpe Road / Yarmouth Road / Harvey Lane	Inbound	-3.0	-1.0	-1.0	-4.0	-1.0	0.0
		Outbound	-13.0	-8.0	0.0	-16.0	-8.0	0.0
62	Yarmouth Road – Village Green on-street parking	Outbound	0.0	-1.0	0.0	0.0	-2.0	0.0
63	Yarmouth Road / Thunder Lane	Inbound	-8.0	-3.0	-2.0	-8.0	-3.0	-1.0
		Outbound	-1.0	-1.0	-1.0	-1.0	-1.0	-2.0
64	Yarmouth Road / Pound Lane Junction	Outbound	-2.0	-15.0	-29.0	-3.0	-15.0	-28.0
27/28/ 29	Wroxham Road: Extend bus lane and make 24hr	Inbound	-12.0	-8.0	-11.0	-12.0	-8.0	-10.0

3.8.41 Figure 43 maps the time savings applied to the bus stop pairs for the 2023 AM peak hour.

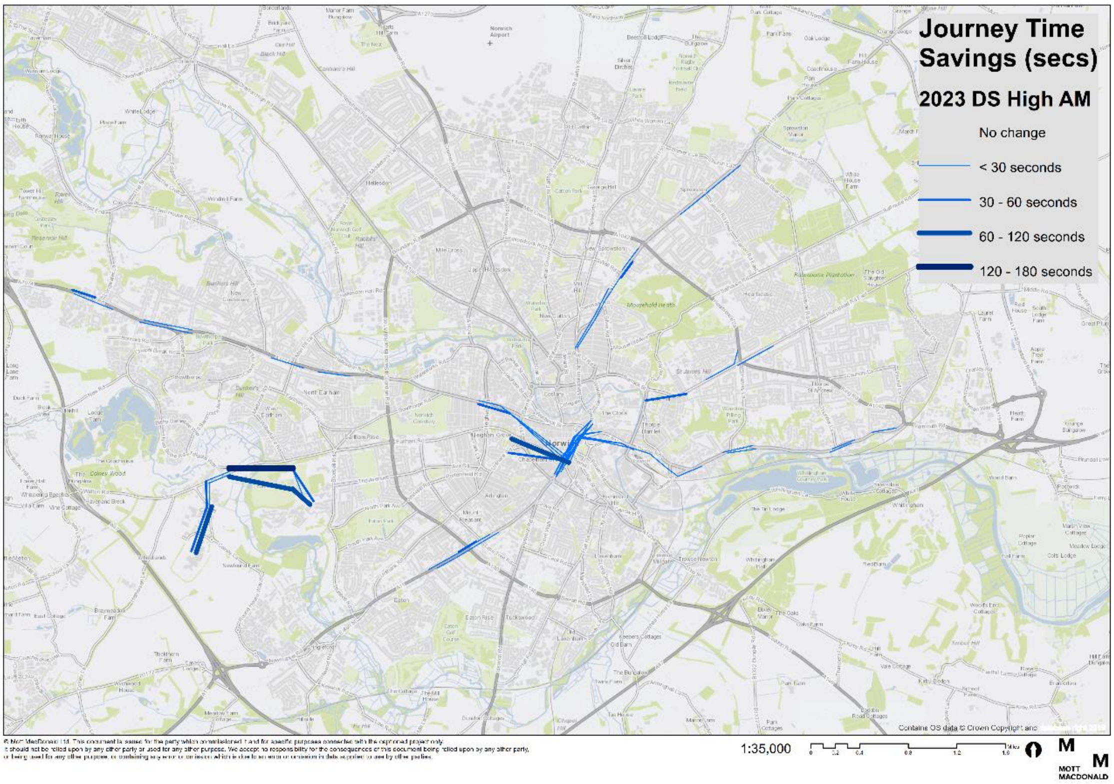


Figure 43: Map of Journey Time savings applied to the bus stop pairs for the 2023 AM peak hour

Wait time savings

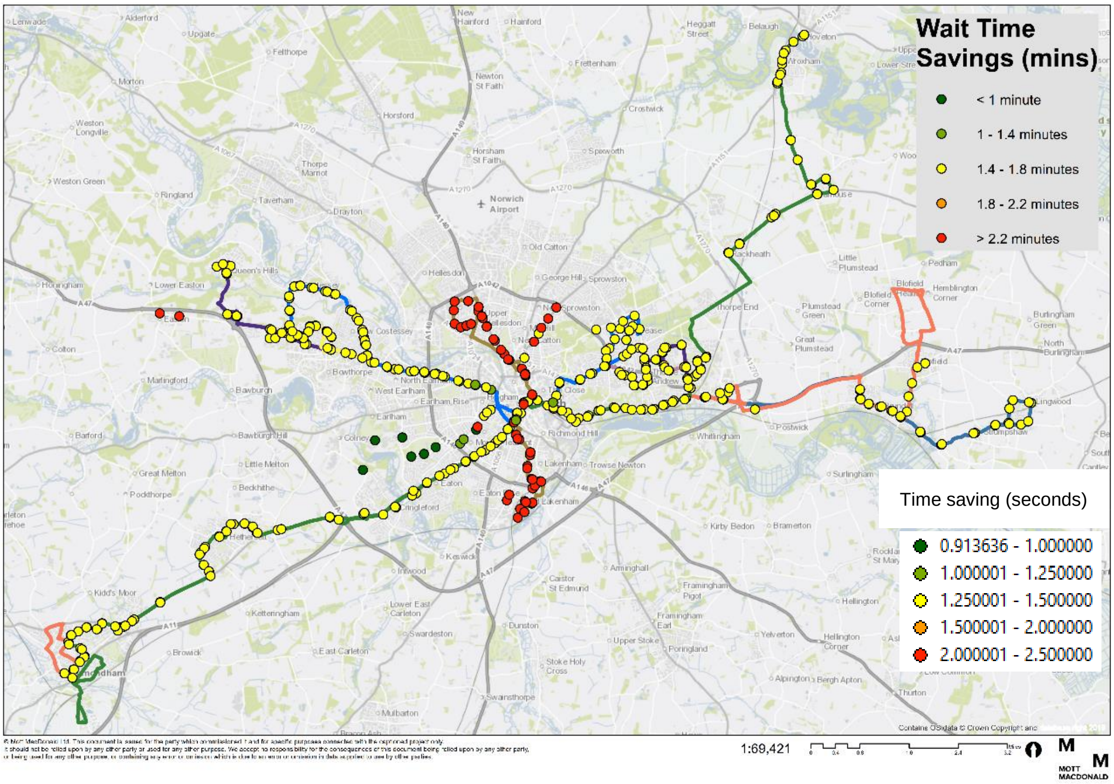
3.8.42 In addition to the journey time savings from the bus-based schemes, First Bus have indicated that they would run more frequent services for some routes as a result of the time savings that the schemes would provide, which would provide wait time savings for passengers. First Bus provided their calculations for the increased frequencies which indicated the following frequency improvements (Table 29):

Table 29: Bus frequency improvements

Route ID	Current frequency	New frequency	Wait time saving
39/39A	20 mins	15 mins	2.5 mins
14/15/15A	15 mins	12 mins	1.5 mins
23/23A	15 mins	12 mins	1.5 mins
24/24A	15 mins	12 mins	1.5 mins

3.8.43 These were converted to wait time savings for the bus stops served by these routes based on the assumption that wait time is half of the time between successive buses. If the bus stop was also served by other routes without a frequency increase, this was reflected by taking an average of the savings across all bus routes at each stop.

3.8.44 Figure 44 illustrates the average wait time savings per bus stop.



Source: Mott MacDonald

Figure 44: Average wait time saving per bus stop

Demand response

3.8.45 To model the demand response to journey time savings, a power elasticity function was used as described in TAG Unit M2 Appendix A.

3.8.46 The Power elasticity formulation is:

$$T_{ij} = g_{ij} * {}_0T_{ij} * \left(\frac{G_{ij}}{{}_0G_{ij}}\right)^A$$

Where:

T_{ij} is the number of trips between zones i and j in the DS

G_{ij} is the DS generalised cost

g_{ij} is the forecast growth rate relative to DM

${}_0T_{ij}$ is the number of trips in the DM

${}_0G_{ij}$ is the DM generalised cost

A is the elasticity.

3.8.47 The components of Generalised Cost are:

- In-Vehicle Time
- Wait Time
- Access/Egress Time
- Fares

3.8.48 In-Vehicle time is the time a passenger is on the bus. This incorporates travel time and dwell time. IVT was skimmed from the model.

3.8.49 Wait time is the time spent waiting at a bus stop. It was assumed that wait time is half the frequency, which was determined for each bus route and bus stop from the Prospective data. Where there was no data, a 5-minute wait time was assumed. This was taken from the fact that DfT have a target for frequency of 10 minutes. This was assumed to be a reasonable period. Wait time was assumed constant over the years.

3.8.50 Access and Egress time is the time taken to walk to / from the bus stop. It was estimated based on the distance between bus stop and LSOA centroid. A 5 km/h walking speed was assumed to convert distance travelled into time. Access and Egress time was assumed constant over the years.

3.8.51 The fare component is the average fare a passenger pays per trip. It was converted to time units by using a Value of Time (VOT) value derived from

Table A1.3.2 'Parameters' of the TAG data book. Fares were uplifted for each forecast year..

3.8.52 The recommended GJT bus elasticity (Table 30) was taken from Table A4 of the DfT report: Bus fare and Journey Time elasticities and diversion factors for all modes.

Table 30: GJT Bus Elasticity

	GJT Bus Elasticity
Overall	-1.1

3.8.53 Generalised Journey Time (GJT) is a term covering In-Vehicle Time and Wait Time only and is just one component of Generalised Cost (GC). Following guidelines in TAG, it was necessary to convert the GJT elasticity value to an equivalent GC elasticity value by multiplying through by the ratio of GC/GJT. This was calculated separately for each OD pair.

3.8.54 The demand response was calculated independently for each origin and destination pair, forecast year (2023, 2038), time period (AM, IP, PM), and scenario (Low, Medium, High).

Appraisal method

Scheme Costs

3.8.55 The base scheme costs and assumptions on risk and inflation were provided by NCC.

3.8.56 The risk was assumed to be 15% of the base cost. The real inflation (over and above background inflation) was assumed to be 3.6% per year. Finally, an Optimism Bias of 44% was included.

3.8.57 The costs of the schemes were presented in the spreadsheet per financial year 2019/20-2022/23 (from April to April). The cost for each calendar year was determined by pro-rating by the number of months in each financial year (0.75 of the cost of the first year and 0.25 of the cost of the second year) and the percentage distribution per year was calculated.

User benefits

3.8.58 The latest version of TUBA v1.9.13 was used to calculate the user benefits of the three scenarios. The opening year for the schemes was 2023 and the benefits were calculated over a 60-year appraisal period.

3.8.59 Table 31 details the TUBA scheme file assumptions. The model represents all bus passengers regardless of journey purpose, which is reflected by the parameter values chosen.

Table 31: Scheme file parameter assumptions

Parameter	Value	Descriptor
Mode	2	Bus
Vehicle Type/Sub-mode	6	Bus
Person Type	2	Passenger
Purpose	0	(TUBA applies a purpose split appropriate for bus)

3.8.60 Table 32 shows the TUBA data code and units used for each of the input matrices.

Table 32: Input matrix type and units

Matrix Type	Code	Units
Passenger trips	P	Trips
Time	T	Hours
Distance	D	Kilometres
Charge (PT Fares – private operators)	C1	Pence

3.8.61 Annualisation factors were calculated from the full year of August 2018 to July 2019 Boardings data from Prospective. Total September weekday trips by hourly period were compared to the full period totals. Then, these period totals were compared to yearly totals. The total boardings by period used to derive the factors can be seen in Table 33. These were combined to give factors from AM/IP/PM hour to Year, which can be seen in Table 34. The off-peak (19:00-07:00) and weekends were incorporated into the IP year component.

Table 33: Total boardings by period

Time Period	Total boardings
AM period	216,312
IP Period	423,748
PM Period	202,596
OP Period	65,545
September Weekends Total	242,628
Yearly Total	13,632,545

Table 34: Annualisation Factors

Time Period	Annualisation Factor
AM peak hour to year	745
Inter-peak average hour to year (7 day)	1933
PM peak hour to year	658

Mode shift

3.8.62 To calculate the mode shift from car as a result of the bus journey time savings, diversion factors (Table 35) were sourced from TAG Table A5.4.6 (National Weighted Mean). The value for a Metropolitan with no light rail show that for every 100 bus passenger increase, 30 people would no longer use a car. The diversion factor was applied with average car occupancies (Table 36) from TAG Table A1.3.3, by time period, to convert from a reduction in car passenger trips to a reduction in car trips.

Table 35: Bus diversion factor for Cars (Metropolitan with no light rail)

Recipient mode	Source mode	Diversion factor
Bus	Car	0.30

Table 36: Car and Vehicle occupancies by time period (average car)

Period	Car Occupancy per Trip
AM	1.43
IP	1.55
PM	1.48

Quality benefits

3.8.63 Additional journey quality benefits were derived by applying the generalised time savings provided in TAG databook M3.2.1 to the bus stops that will be upgraded and the bus stops that will be part of a Mobility Hub. The benefits were calculated by running these generalised time savings through TUBA which applies the time savings to the number of passengers boarding at each bus stop. The generalised time savings extracted from TAG are 1.08 minutes for new bus shelters and 1.27 for new interchange facilities.

3.8.64 Note that these generalised time savings were not included in the demand response, therefore are a conservative estimate of the quality impacts

Marginal benefits

3.8.65 Additional benefits were derived by applying the Marginal External Cost (MEC) factors to the reduction in car-km. MECs were extracted from TAG Table 5.4.2 for the following:

- Decongestion (travel time) for road traffic;
- Maintenance;
- Accidents;
- Air quality;
- Noise; and
- Greenhouse gases.

Capturing non-First Bus benefits

3.8.66 In Norwich, passengers on First Bus vehicles account for around 85% of bus trips. The remaining passengers are on Park & Ride and other operators. The core methodology only takes account of First Bus passengers, as data on journey times for the other bus services was not available within the timescales. To capture these missing benefits, an assumption was made that the other bus passengers would receive, on average, the same benefits per passenger as the First Bus passengers. Therefore, an uplift factor of 1.15 was applied to the PVB. The uplift factor was calculated as the ratio of annual First Bus boardings relative to other bus boardings.

3.8.67 In addition, three of the bus schemes are on the Airport corridor but it was not possible to model these as no journey time data was available. To capture these missing impacts, an assumption was made that these three schemes would each yield benefits equivalent to the average benefits per scheme from the other schemes that could be modelled. Further, an assumption was made that these benefits would only be experienced by the 15% of 'non-First' bus passengers.

3.9 Walking and cycling methodology

Methodology

3.9.1 DfT's Active Mode Appraisal Toolkit (AMAT) has been used for all walking and cycling measures. Full details can be found in Appendix 7 & Appendix 8.

3.9.2 To estimate the current number of cycle users on each corridor, the data from the Propensity to Cycle Tool was used. This provides commuting data from the census and plots the movements on routes using the existing network available. To estimate the number of users on each route, the Propensity to Cycle Tool "Fast Route" data set was used. Using the QGIS software we were able to count the number of routes that used the corridor. This was based within 400m of the routes to align with the mobility working where we have looked at key mobility improvements as part of the mobility hub design work. Once the number of routes had been calculated, we were then able to use the QGIS software to work out the percentage of the route that used the infrastructure on the corridor and were therefore able to estimate the average percentage of a trip on each corridor on an average trip.

3.9.3 The number of trips on the corridor was then multiplied by 6.51% to factor in the growth in Norwich's population from 135,512 (2011 Census) to 156,600 (source 2018 Office for National Statistics Population Estimates).

3.9.4 Following on from the number of cycle users we estimated the daily usage by multiplying the total by 0.72 (for an average of 5.1 cycle trips a week based on the National Travel Survey Data).

3.9.5 AMAT produces the following user benefits and externalities:

- Journey ambience
- Physical activity (mortality and absenteeism)
- Decongestion (travel time) for road traffic
- Maintenance
- Accidents
- Air quality
- Noise
- Greenhouse gases

3.9.6 A separate appraisal has been completed for each individual corridor. These will be combined to give benefits for the total walking and cycling package, with due consideration given to avoiding double counting of benefits.

Total package benefits

- To obtain benefits for the whole package, the general approach will be to sum the impacts from the three categories of intervention. However, it is recognised that there will be some interactions that would lead to double counting if the benefits were simply added together.
- Specifically, the bus improvements will attract some trips that would otherwise walk or cycle, thereby reducing the impact of the walking and cycling measures, and vice versa. The WebTAG bus diversion factors referred to above will be used to understand the degree to which this is likely to occur, and a suitable adjustment will be made when combining the benefits.

3.10 Secondary mode shift (sensitivity test)

3.10.1 The impact on car, bus and walk/cycle demand has been calculated with three separate single-mode models that capture the primary demand response but do not capture the secondary push and pull of trips between modes. A multi-modal model would have taken account of all these effects. In the absence of a multi-modal model, a sensitivity test was undertaken using diversion factors to calculate the secondary demand responses.

3.10.2 The primary and secondary demand responses and how they have been calculated, are illustrated in **Error! Reference source not found.**. The diversion factors were sourced from DfT report ‘Bus fare and journey time elasticities and diversion factors for all modes’[13].

[13] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/719278/bus-fare-journey-time-elasticities.pdf

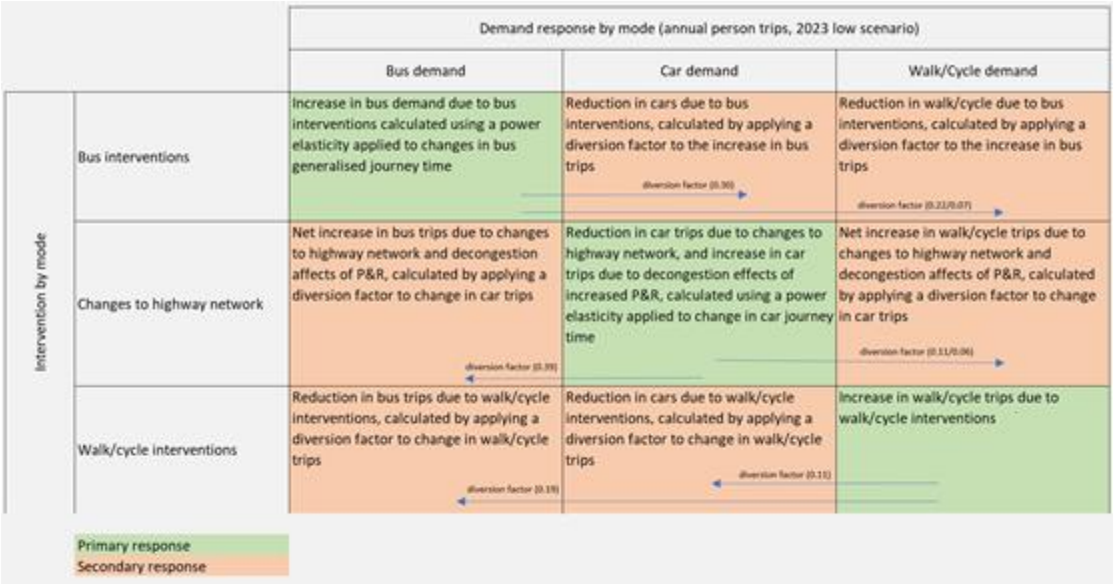


Figure 45: Secondary mode shift methodology

3.11 Results of transport appraisal

Results of appraisal of highway schemes

3.11.1 The model shows that the 'Transforming Norwich' proposals are likely to have an adverse impact to the highway network. This is an expected outcome given that many of the measures remove highway capacity or require traffic to reassign to longer routes.

3.11.2 As the highway modelling does not fully reflect the potential decongestion impact of the 'Transforming Norwich' proposals it is likely that the adverse impact evident in the model (and the level of negative benefit derived within TUBA) is likely to be an over-estimate of the real impact of the TCF proposals.

3.11.3 Table 37 below shows a breakdown of the highway user benefits calculated for each 'Transforming Norwich' package.

Table 37: Highway user benefits (£000s, present values discounted to 2010, in 2010 prices)

Element	Low Package	Medium Package	High Package
Travel Time Savings	-85,150	-82,485	-82,263
Vehicle Operating Costs	-10,920	-11,371	-11,797
Indirect Tax Revenue	2,551	2,628	2,732
Total PVB	-93,519	-91,228	-91,328

3.12 Results of appraisal of public transport improvements

Demand response

3.12.1 The scale of demand response across the whole network can be seen in Table 38.

Table 38: Base, DM, DS bus trips

Scenario	Annual Bus Trips	Difference from Base	Difference from DM	% Difference from Base	% Difference from DM
Base	15,730,015	0	0	0.0%	0.0%
2023 DM	16,205,387	475,372	0	3.0%	0.0%
2023 DS Low	17,081,962	1,351,947	876,576	8.6%	5.4%
2023 DS Medium	17,179,105	1,449,090	973,718	9.2%	6.0%
2023 DS High	17,188,168	1,458,153	982,782	9.3%	6.1%
2038 DM	17,601,023	1,871,008	0	11.9%	0.0%
2038 DS Low	19,176,992	3,446,977	1,575,969	21.9%	9.0%
2038 DS Medium	19,321,421	3,591,406	1,720,398	22.8%	9.8%
2038 DS High	19,331,378	3,601,363	1,730,355	22.9%	9.8%

3.12.2 Table 39 presents the user benefits and operator revenue benefits for each scenario. The low scenario represents high value for money, and the medium and high scenario both represent medium value for money, using VfM category definitions in TAG. For consistency, only the costs for schemes that benefits have been estimated for, are included in the Benefit Cost Ratio.

Table 39: TUBA results (£000, 2010 prices)

£000s	User Benefits	Revenue Benefits	Journey Quality	Indirect tax	PVB	PVC	BCR
Low	39,468	31,704	20,725	-5,019	86,878	23,082	**3.764**
Medium	47,851	35,905	19,860	-5,677	97,939	37,158	**2.636**
High	48,551	36,009	20,273	-5,725	99,108	38,519	**2.573**

Capturing non-First bus benefits and journey quality benefits

3.12.3 In Norwich, passengers on First Bus vehicles account for around 85% of bus trips. The remaining passengers are on Park & Ride and other operators. The core methodology only takes account of First Bus passengers, as data on journey times for the other bus services was not available within the timescales. To capture these missing benefits, an assumption was made that the other bus passengers would receive, on average, the same benefits per passenger as the First Bus passengers. Therefore, an uplift factor of 1.16 was applied to the PVB. The uplift factor was calculated as the ratio of annual First Bus boardings relative to other bus boardings. Table 40 shows the bus benefits for First bus passengers uplifted to account for non-First bus passengers.

Table 40: Bus benefits uplifted with non-First passengers (£000, 2010 prices)

£000s	User Benefits	Revenue Benefits	Journey quality	Indirect tax	PVB	PVC	BCR
Low	45,664	36,681	23,979	-5,807	100,517	23,082	**4.355**
Medium	55,363	41,542	22,978	-6,568	113,314	37,158	**3.050**
High	56,173	41,662	23,456	-6,624	114,667	38,519	**2.977**

3.12.4 In addition, three of the bus schemes are on the Airport corridor but it was not possible to model these as no journey time data was available. To capture these missing impacts, an assumption was made that these three schemes would each yield benefits equivalent to the average benefits per scheme from the other schemes that could be modelled. Further, an assumption was made that these benefits would only be experienced by the 15% of ‘non-First’ bus passengers. In addition, the journey quality benefits have been added using the method described in the previous chapter. Table 41 shows the final bus benefits, accounting for First bus passengers, non-First bus passengers and the three bus schemes on the Airport corridor.

Table 41: Bus benefits with non-First passengers and Airport corridor schemes (£000, 2010 prices)

£000s	User Benefits	Revenue Benefits	Journey quality	Indirect tax	PVB	PVC	BCR
Low	46,826	37,614	23,979	-5,955	102,464	24,039	**4.262**
Medium	56,436	42,347	22,978	-6,696	115,065	38,114	**3.019**
High	57,212	42,437	23,456	-6,746	116,359	39,679	**2.933**

3.12.5 TUBA warnings were looked at, but there were none found to be serious, as summarised in Table 42. This was expected as the input change in costs were completely controlled. All warnings referred to the 'ratio of DM to DS travel time'.

Table 42: Number of TUBA warnings

Scenario	Warnings	Serious Warnings
Low	1,308	0
Medium	1,326	0
High	1,332	0

Mode shift

3.12.6 Using the diversion factors, the reduction in cars and car-km as a result of the bus journey time and wait time reductions, is shown in Table 43.

Table 43: Reduction in car trips and car-km

Scenario	2023 Annual reduction		2038 Annual reduction	
	Car trips	Car-km	Car trips	Car-km
Low	153,115	757,472	223,974	1,557,520
Medium	172,587	921,820	252,924	1,787,477
High	174,414	935,860	254,932	1,803,071

Marginal benefits

3.12.7 Using the MECs, the marginal benefits as a result of the reduction in car-km, is shown in Table 44.

Table 44: Marginal benefits (£000s, 2010 prices)

	Low Marginal benefits (£000s)	Medium Marginal benefits (£000s)	High Marginal benefits (£000s)
Decongestion for road traffic	8,517	9,815	9,906
Maintenance	49	56	57
Accidents	2,865	3,300	3,331
Air quality	25	29	29
Noise	152	176	177
Greenhouse gases	150	173	175

3.13 Results of appraisal of walking and cycling measures

Overview of the Low cost scenario

3.13.1 The low cost scenario will improve five key walking and cycling corridors (there are no schemes on the Broadland Business Park corridor in the low cost scenario). They will have a range of improvements including new and improved facilities and improved links into the public transport network through the improvements identified by the mobility hubs. Table 45 below provides an overview of the BCRs for each of the corridors modelled. Table 46 below gives an overview of the total BCR for the low programme. Table 47 gives a modal shift overview.

Table 45: Overview of the BCRs of the corridors

Location	City Centre	Airport	Easton	Rackheath	Sprowston	Wymondham
BCR	1.89	4.11	1.97	2.68	4.00	3.84
PVB (£000s)	33,425	15,879	17,450	7,593	14,636	25,474
PVC (£000s)	17,697	3,862	8,852	2,828	3,663	6,633

Table 46: Overview of the Total BCRs

Total PVB (£000s)	114,456
Total PVC (£000s)	43,535
BCR	2.63

Table 47: Modal shift overview

Mode	Airport	City Centre	Easton	Rackheath	Sprowston	Wymondham
Cycle Current	7.70%	7.37%	8.85%	6.11%	7.77%	9.76%
Cycle after TCF	10.00%	9.58%	11.51%	7.94%	10.10%	12.69%
Pedestrian Current	11.53%	22.49%	13.81%	10.80%	16.04%	16.37%
Pedestrian after TCF	13.60%	26.54%	16.29%	12.74%	18.93%	19.32%

3.13.2 The low cost scenario in total provides a BCR of 2.63 across the five corridors assessed and the city centre. This is based on a 30% growth in cycling and 18% growth in walking, modelled from what we have seen as growth from existing walking and cycling improvements implemented since 2010 in the Norwich area. The modal shift resulting from the low cost programme is shown in Table 48below.

Modal shift overview

Total modal shift for the Low cost scenario

Table 48: Total modal shift for the Low Cost Scenario

Mode	Total
Cycle Current	8.09%
Cycle after TCF	10.51%
Pedestrian Current	15.99%
Pedestrian after TCF	18.86%

Overview of the Medium cost scenario

3.13.3 The Medium cost scenario adds in an additional scheme with specific cycling and walking benefits, Lion Wood. As the Lion Wood scheme does not complete a new corridor, a scheme level AMAT has been run for this. The results of this scheme are shown in Table 49 below.

Table 49: Overview of costs and benefits for the Lion Wood scheme in the medium scenario

Location	Lion Wood
BCR	6.18
PVB (£000s)	2,198
PVC (£000s)	355

3.13.4 As this scheme is not located close to the corridors in the low scenario, there is little risk of double counting of benefits. Therefore, the additional costs and benefits of the Lion Wood scheme have been added to those from the low scenario to provide a total value for the Medium package (Table 50).

Table 50: Overview of costs and benefits for the Medium scenario

Location	Medium Total
BCR	2.66
PVB (£000s)	116,654
PVC (£000s)	43,890

Overview of the High cost scenario

3.13.5 The High cost scenario adds in an additional corridor providing a link to the Broadland Business Park and also improvements for the St Stephen's roundabout, one of the busiest pedestrian junctions in Norwich. A corridor assessment was completed for the Broadland corridor improvements and a scheme level assessment was completed for the improvements on St Stephen's roundabout.

3.13.6 Table 51 below provides an overview of the BCRs for each of the corridors modelled and Table 52 outlines the modal shift.

Table 51: Overview of the BCRs

	Airport	City Centre	Easton	Rackheath	Sprowston	Wymondham	Yarmouth Rd	St Stephens roundabout	High Total
BCR	**4.11**	**1.89**	**1.97**	**2.68**	**4.00**	**3.84**	**0.67**	**2.17**	**2.39**
PVB (£000s)	15,879	33,425	17,450	7,593	14,636	25,474	**3,700**	**9,528**	**127,684**
PVC (£000s)	3,862	17,697	8,852	2,828	3,663	6,633	**5,514**	**4,393**	**53,442**

Total modal shift for the High Cost Scenario

Table 52: Total modal shift for the High Cost Scenario

Mode	Total
Cycle Current	7.94%
Cycle after TCF	10.34%
Pedestrian Current	15.53%
Pedestrian after TCF	18.32%

3.13.7 From the transport modelling, we have estimated the current modal split for journeys using the corridors. Using the 30% growth in cycle trips and 18% growth in walking numbers, we have identified the modal shift due to these interventions.

3.13.8 The total mode share for cycling will increase from 7.94% to 10.34%, an increase of 2.4%. This brings the mode share for cycling across the corridors, in total, to a similar level to that seen currently in the Wymondham corridor (which encompasses travel to UEA, the Norwich Research Park and the Norfolk & Norwich University Hospital). Therefore, this level of mode share is seen as achievable.

3.13.9 The total mode share of pedestrian trips will increase from 15.53% to 18.32%, achieved by the wide range of walking improvements implemented through the mobility hub zones. This is still below the levels we already see in the city centre of 22.49% and with the improvements to multi-modal transport opportunities through improvements to the public transport network and the implementation of the bike hire scheme this looks very achievable.

3.13.10 We estimate the total amount of new trips created by walking and cycling to be 11,929 per day as a result of the improved infrastructure. Using the standard diversion factor that 11% of these walking and cycling trips would have been car trips in the absence of the investment, this results in a saving of 1,312 car trips per day on these corridors and in the city centre.

Secondary mode shift (sensitivity test)

3.13.11 The secondary mode-shift impacts have been captured using diversion factors. The impact on demand is shown in Figure 46. For comparison purposes, demand is shown as annual person trips and represents the 2023 low scenario. The sensitivity test has been undertaken on the core passenger numbers before uplifts for non-First passengers were applied.

3.13.12 The increase in bus trips due to the bus interventions is offset by the pull from bus to walk/cycle due to the walk/cycle interventions, leaving a net increase in bus trips of 266,913 (1.6%) passengers per annum.

3.13.13 The net increase in walk/cycle trips is 4.03 million (15.5%).

3.13.14 Car person trips are reduced by 1.1 million (0.9%) per annum. The bus interventions contribute to more than half of the reduction in car trips. The remainder being attributable to the walking and cycling interventions.

3.13.15 The method for calculating bus passenger increases is different to that used to calculate walk/cycle increases. There would also be a proportion of the walk increase that would still use bus, and we haven't been able to capture this. Due to these limitations the multi-modal sensitivity test results should be used with caution.

Figure 46: Secondary mode shift results

Intervention by mode		Demand response by mode (annual person trips, 2023 low scenario)		
		Bus demand	Car demand	Walk/Cycle demand
	Bus interventions	Increase in bus demand due to bus interventions calculated using a power elasticity applied to changes in bus generalised journey time DM bus trips 16,205,387 Change in bus trips 876,576	Reduction in cars due to bus interventions, calculated by applying a diversion factor to the increase in bus trips diversion factor (0.30) Change in car trips - 262,973	Reduction in walk/cycle due to bus interventions, calculated by applying a diversion factor to the increase in bus trips diversion factor (0.22/0.07) Change in w/c trips - 254,207
	Changes to highway network	Net increase in bus trips due to changes to highway network and decongestion affects of P&R, calculated by applying a diversion factor to change in car trips diversion factor (0.3) Change in bus trips 150,178	Reduction in car trips due to changes to highway network, and increase in car trips due to decongestion effects of increased P&R, calculated using a power elasticity applied to change in car journey time DM car trips 122,990,592 Increase in car trips Reduction in car trips Net change in car trips - 385,072	Net increase in walk/cycle trips due to changes to highway network and decongestion affects of P&R, calculated by applying a diversion factor to change in car trips diversion factor (0.11/0.06) Change in w/c trips 65,462
	Walk/cycle interventions	Reduction in bus trips due to walk/cycle interventions, calculated by applying a diversion factor to change in walk/cycle trips diversion factor (0.19) Change in bus trips - 759,841	Reduction in cars due to walk/cycle interventions, calculated by applying a diversion factor to change in walk/cycle trips diversion factor (0.11) Change in car trips - 464,347	Increase in walk/cycle trips due to walk/cycle interventions DM w/c trips 26,061,365 Change in w/c trips 4,221,338
	Change in trips	DM bus trips 16,205,387 DS bus trips 16,472,300 Net change in bus trips 266,913 Net change in bus shar 1.6%	DM car trips 122,990,592 DS car trips 121,878,200 Net change in car trips - 1,112,392 Net change in car share -0.9%	DM w/c trips 26,061,365 DS w/c trips 30,093,958 Net change in w/c trips 4,032,593 Net change in w/c shar 15.5%

Primary response
Secondary response

3.13.16 The revised bus demand for the sensitivity test was run through TUBA to assess the impacts on benefits. The results are shown in Table 53. The transport user benefits reduce slightly as expected, however the revenue benefits reduce significantly as the net increase in bus passengers falls from 876,576 to 266,913.

Table 53: Bus benefits results capturing secondary mode shift (£000, 2010 prices)

£000s	User Benefits	Revenue Benefits	Indirect tax	PVB	PVC	BCR
Primary	39,468	31,704	-5,019	66,153	23,082	**2.866**
Primary + Secondary	38,693	8,311	-1,349	45,655	23,082	**1.978**

Level 2 Wider Economic Impacts Appraisal

Introduction

3.13.17 This section examines the wider economic impacts for the preferred option that are additional to the transport user benefits. These benefits are calculated following TAG Unit A2.1[14] guidance.

3.13.18 TAG Unit A2.1 defines wider economic impacts as the impacts of transport interventions on welfare at a national level that are not captured by a conventional appraisal of transport user benefits. These impacts have traditionally been omitted because the conventional appraisal assumes theoretical 'perfectly competitive' transport-using markets whereas, in reality, markets are imperfect, leading to the potential for additional benefits (or disbenefits).

3.13.19 TAG defines these Level 2 wider economic impacts as relating to implicit land use changes i.e. any change in land use as a result of the scheme is implicit rather than explicit. Impacts related to explicit land use changes are captured as part of Level 3 benefits/disbenefits (the approach to calculating these benefits, including their definitions, are set out in detail in section 8).

3.13.20 Those impacts that will inform the Level 2 benefits/disbenefits associated with the programme and will be included in an 'adjusted BCR'. These level 2 benefits are:

- Agglomeration;
- Labour supply impacts;
- Output change in imperfectly competitive markets.

[14] Department for Transport, May 2018, TAG Unit A2.1, Wider Economic Impacts Appraisal https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/712878/tag-unit-a2-1-wider-impacts-overview-document.

3.13.21 The definitions of these impacts are set out in Table 54.

Table 54: Level 2 benefits

Benefits	Definition
Agglomeration (TAG Unit A2.4)	• Agglomeration refers to the concentration of economic activity over an area. Transport can increase the accessibility of an area for businesses and workers, therefore impacting on the level of agglomeration, through the reduction of generalised costs for business and commuting trips. • The level of agglomeration reflects the productivity benefits experienced by businesses as a result of improved connections to other businesses and to potential employees thus improving interaction, knowledge exchange and access to markets, including labour markets.
Labour supply impacts (TAG Unit A2.3)	• Transport can have an impact on labour supply by affecting the overall costs and benefits to individual workers. An individual will weigh the cost of travel against the wages of a job travelled to. • Changes in transport costs is likely to have an impact on the incentives of individuals to work and hence have an impact on the overall level of labour supplied in the economy. • This can have a positive impact on the economic at a national level with an increase in potential workers employed affecting the level of UK Gross Domestic Product (GDP) through increases in tax revenues.
Output change in imperfectly competitive markets (TAG Unit A2.2)	• Markets are generally considered not to be perfectly competitive, thus leading to lower production and higher prices than would exist in a perfectly competitive market. • This is seen as being detrimental to consumers and the economy as a whole. • Reductions in transport costs allows for an increase in production in the goods and services that use transport, reducing costs so that businesses can make more profit or pass on the saving to customers, so they can be more competitive.

Source: WebTAG Unit A2.1

3.13.22 Within the context of the '**Transforming Norwich**' programme for Greater Norwich, our opinion is that it will only be proportionate to assess labour supply impacts, in line with the objectives of the programme.

Labour supply impacts

3.13.23 In recent years, the Economic and Social Development (ESD) team at Mott MacDonald have developed a specialism for assessing the labour market catchments of locations, or changes resulting from scheme improvements to quantify a change in catchment area.

3.13.24 An automated tool has been developed to standardise this process. The tool uses GIS technology to calculate car or public transport catchment areas representative of the maximum time a worker would be willing to travel to work.

3.13.25 The second stage of the tool looks to sum up the totals of additional workers who would be willing to travel to work based on journey times for each route.

3.13.26 The comparator tables are then fed into a graphic summary report, showing the tables and charts to present the data, and also maps showing the drive-time catchment bands. The technique is particularly useful to highlight changes in potential labour market pools resulting from transport schemes that improve travel time.

Results of Level 2 wider economic impacts appraisal (sensitivity test)

3.13.27 We modelled the increase in the number of workers who would be travelling 30 minutes or less to the city centre along each corridor that has a current bus journey time of 30 minutes or more. The results are shown in Table 55 below.

Table 55: Summary of additional workers within a 30-minute travel time of the city centre by corridor

Route	Population within 400m of a bus stop in the 2023 Do Minimum scenario - AM peak	Population within 400m of a bus stop in 2023 Do Something scenario - AM Peak	Additional number of population who can access a stop
Broadland	18,014	18,378	364
Wymondham	23,861	25,181	1,320
Easton	27,479	27,482	3

3.13.28 The results show that the most significant increase in labour catchment occurs on the Wymondham corridor, with an additional 1,320 workers able to access a bus stop within 400m that has a journey time of 30 minutes or less to the city centre. The equivalent figure for Broadland is 364 workers, while the Easton has only an additional 3 workers due to the fact the current journey time on the corridor is very close to 30 minutes. In total, the Norwich TCF programme allows an additional 1,683 workers to access jobs in the city centre.

Level 3 Supplementary economic modelling appraisal

Definition and measurement of supplementary wider economic impacts

3.13.29 This section examines the additional wider economic benefits for the proposed public transport interventions in Norwich programme relating to Level 3 benefits as defined within DfT’s WebTAG Unit A2.1 guidance. TAG defines these Level 3 wider economic benefits as relating to explicit land use changes. These are assessed through supplementary economic modelling.

3.13.30 A key purpose of the ‘**Transforming Norwich**’ application is to support the continued economic growth of Greater Norwich by providing new transport infrastructure that will provide effective links to key development sites, supporting housing and employment growth. Therefore, it is critical that the business case, whilst adhering to DfT’s WebTAG Unit A2.1 guidance, looks more widely from an economic development perspective at how the programme supports economic growth in Greater Norwich.

3.13.31 Level 3 supplementary wider economic benefits cover the following areas:

- Land utilisation benefits
- Access to more productive jobs
- Reductions in spatial inequalities and structural unemployment
- Land Value Uplift (LVU) assessment
- Transport External Costs
- Option and non-use values (if appropriate)

3.13.32 Within the TCF, we consider that it will only be proportionate at a programme level to assess the impact of the programme on land use in terms of dependent development and the GVA and jobs generated by this development

Level 3 benefits assessment

3.13.33 The first step was to model potential land use change along each of the priority corridors. Our approach is:

- Collate data on potential development sites within a reasonable catchment area of bus stops from SHLAA/Local Plan data;
- Assess how far allocated sites could be intensified and/or unviable sites could be brought forward as a result of this accessibility improvement, potentially including local market engagement where required and/or taking a view on land value uplift using high level viability assessments;
- Set out our assessment of sites that could be developed (usage, development quantum, phasing) within the catchment areas along each corridor.

Assessing jobs and GVA impacts using TEAM model.

3.13.34 Having identified anticipated land-use changes across the priority corridors, Mott MacDonald would apply its proprietary Transparent Economic Assessment Model (TEAM), which assesses the economic benefits arising from land-use change, calculated in line with HM Treasury Green Book principles of additionality.

3.13.35 The model assesses the core economic benefits of the associated land-use changes relating to jobs and GVA. The model uses Office of National Statistics (ONS) datasets alongside bespoke local area analysis to inform specific assumptions. The economic benefits calculated by TEAM are quantified in terms of net job creation and GVA, which would input to the economic narrative in the Economic Case.

Growth Locations

3.13.36 To account for the broader economic effects that would stem from the '**Transforming Norwich**' programme, various site allocations, or growth locations, specified in the local plans of NCC, Broadland and South Norfolk, as well as the JCS, have been assessed. Each site allocation from the local plans has been mapped in relation to the proposed bus transit corridor developments, and has only been incorporated into the analysis scope if it sits within a suitable distance of at least one corridor, in this case 800m. Once all the sites within a suitable distance of a bus corridor had been established, the following criteria were applied to identify those sites that would offer benefits worth including in the economic impact analysis.

- Residential land: sites included if proposed number of dwellings are greater than 100
- Employment land: sites included if hectarage of land is greater than 2 ha

3.13.37 After these criteria were applied, there were 34 residential growth locations and 20 commercial growth locations that were suitable for inclusion. These are shown in the Technical Note of Calculation of Level 3 Benefits in Appendix 6.

Key Sites

3.13.38 Amongst the development sites included in the analysis, there are several key locations. A brief overview for each is given below.

- **Growth Triangle: North Rackheath** – this site plans to build 3,000 homes and develop 25ha of land for employment purposes. Various other uses for the land have been planned, such as road and cycle links, two new primary schools, local centre sports pitches & children's play space, community building, home waste recycling centre & significant informal open space. There is also the possibility for the construction of a new secondary school.
- **Growth Triangle: Land South of Salhouse Road (Lanpro and UB&L) –** plans for these two sites are similar to those for the North Rackheath site. 1,400 homes are expected to be built on the land, whilst also integrating cycle links, a primary school, sports pitches & open space, a community building and a police-beat base.
- **Land at Broadland Business Park, Thorpe St Andrew** – site is allocated for employment uses in professional services, industrial and manufacturing work and distribution.
- **Land Adjacent to Norwich Research Park (NRP) Colney** – allocated for the construction of research and development offices. Some work has already begun on the site.

- **Newfound Farm, Cringleford –** this site is allocated for the development of up to 650 dwellings, as well as a local community centre and primary school.
- **Land at South Wymondham –** this site is to be master-planned as one whole development. The land amounts to 67 hectares and is allocated for housing and associated infrastructure, landscaping and open space. The allocation could accommodate approximately 1230 dwellings
- **Land at North Hethersett, Hethersett** - Due to the size of this allocation, a range of supporting infrastructure and facilities will be required, and the site should be master-planned to maximise integration with the existing settlement and other allocations in Hethersett. Approximately 68ha is allocated for mixed use, to include housing, community uses, open space and green infrastructure. This will include approximately 1,080 dwellings.

Dependency Methodology

3.13.39 Since the objective of this assessment is to ascertain the economic impacts on the surrounding area, that will arise from the proposed bus transit developments in Norwich, only those effects that come as a direct result of the '**Transforming Norwich**' programme should be included in the assessment. The strategic growth locations that have been identified are not entirely dependent on the corridor development, and so it would not be prudent to integrate all economic impacts from the sites in to the wider economic impact of the '**Transforming Norwich**' programme. To align with this, a percentage dependency has been assigned to each strategic growth location. For example, if a site allocation is considered to be 5% dependent on the bus transit development, then only 5% of that sites economic impacts have been included in the '**Transforming Norwich**' economic assessment, since 95% of the impacts for that site would still be present should the '**Transforming Norwich**' programme not go ahead.

3.13.40 Three levels of dependency have been used for the development sites around the bus corridors. These are stated below.

- Low dependency: 5%
- Medium dependency: 50%
- High dependency: 80%

3.13.41 The dependency levels for each site were determined through a review of the site development plans and site transport assessments. For sites that gave no information in the way of dependency on bus or travel or public transport, and for those that stated there were no constraints on development, a dependency of 5% has been assigned. For sites that mentioned public access improvements, a 50% dependency has been assigned. For sites that stated the development is conditional on the resolution of access issues or public transport developments, an 80% dependency has been applied. The dependency levels that have been allocated to each site are shown in the Technical Note of Calculation of Level 3 Benefits in Appendix 6.

Sub National Impacts: Jobs and GVA

3.13.42 For Norwich, Broadland and South Norfolk, based on the assessment of the linkages between the Norwich TDC programme and the sites, the gross direct employment and GVA impacts have been calculated. These relate to the workplace jobs and associated GVA in Greater Norwich that the TCF project is assessed to support. These estimates were calculated using Mott MacDonald's Transparent Economic Assessment Model (TEAM), which is a versatile economic impact modelling tool designed to calculate the economic benefits of proposed infrastructure intervention and policy measures. It has been designed by experts in economics, economic development and regeneration and is in line with HM Treasury Green Book principles and Homes & Communities Agency's (HCA) additionality guidelines and uses the latest economic datasets from the Office of National Statistics (ONS). The tool measures the potential stimulus to economic activity from interventions by estimating the consequential employment, salary, gross value added (GVA) and investment benefits that would otherwise not have arisen. Net impact on jobs and GVA is then estimated.

3.13.43 At a Greater Norwich level, the gross economic impacts of the scheme are anticipated to be within the range of 1,076 total net jobs, 16,278 housing units and £51.0 million of GVA per annum (once all sites are fully built out). The results for jobs and GVA are detailed in Table 56 below:

Table 56: Total Net Jobs and GVA arising from strategic growth locations

Land at Rose Lane and Mountergate	5	£0.3
Land west of Ipswich Road, Keswick	19	£0.9
Land rear/east of Institute of Food Research (IFR), Colney	67	£3.2
Mile Cross Depot	2	£0.1
Land at Aylsham Road	12	£0.6
Hall Road District Centre	5	£0.2
Land at Abbey Farm Commercial, Horsham St Faith	7	£0.3
Barrack Street	5	£0.2
Land at Pinelands, Holt Road, Horsford	3	£0.2
Two sites at Hurricane Way, Airport Industrial Estate	3	£0.1

St Anne's Wharf and adjoining land	1	£0.1
Earlham Hall	4	£0.2
Total	2463	116.9

Source: Mott MacDonald

Cost estimation

Introduction

3.13.44 This section sets out the costs of the options that are captured in the appraisal and explains the costs included and how they are manipulated following TAG guidance to provide Present Value of Costs (PVC). First the capital cost is presented for all options and then the whole life costs (maintenance and renewals) associated with the proposed projects. The risk allowance for each option is presented and then the inflation and optimism bias assumptions are explained. The costs are brought together, adjusted and discounted for inclusion in the cost benefit analysis.

Baseline capital costs

3.13.45 The base cost estimates are presented in Table 57. These show the costs of the schemes in the low, medium and high programmes. We have split out the base cost, inflation and risk allowance to give a total programme cost for the low, medium and high cases.

Table 57: Capital base costs by programme (£000s, 2019 prices)

Corridor	Low £000	Medium £000	High £000
Base Cost	71,729	84,427	138,997
Inflation	7,516	9,422	17,608
Risk	4,716	5,736	11,236
Programme cost	**83,961**	**99,585**	**167,841**

Whole life cost estimates

3.13.46 Whole life cost estimates are calculated by summing the maintenance costs associated with each option over a 60-year period. Given that the programmes do not propose adding new infrastructure, but instead involve schemes such as bus and cycle lanes, we have assumed that the additional maintenance costs associated with these schemes will be negligible.

Inflation and optimism bias

3.13.47 All programme costs have been calculated to increase in line with inflation over the lifecycle of the programme's development and delivery. Inflation has been included at a rate of 3.6% per annum. This is based on the average rate of inflation applicable for similar work carried out in Norwich over the last three years.

3.13.48 Optimism bias has been applied to reflect the current level of design detail for the programme. In line with WebTAG guidance, optimism bias has been applied for each scheme at 44% for the SOBC stage. TAG Unit A1.2 - Table 8 - recommends optimism bias uplift of 44% for road-based schemes, including bicycle facilities, pedestrian facilities, Park & Ride, and bus lane schemes at Stage 1 in development i.e. at SOBC level.

Present Value of Costs

3.13.49 The costs outlined above have been converted to Present Value Costs (PVC), using default discount factors from the May 2019 TAG databook. The overall PVC for the preferred option is shown in Table 58.

Table 58: Project present value costs (£000s, 2010 market prices, discounted to 2010)

	Low Programme PVC (£,000s)	Medium Programme PVC (£,000s)	High Programme PVC (£,000s)
Total PVC	90,584	107,442	181,143
Minus Private Sector PVC	-22,874	-22,879	-35,272
Public Sector PVC	67,711	84,563	145,871

Reporting

3.13.50 The total impact on public accounts is estimated to be £67.71m (2010 prices) for the low programme, £84.56m for the medium programme and £145.87m for the high programme of which all is a cost to central and local government.

Value for Money

Introduction

3.13.51 The Value for Money (VfM) statement for the '**Transforming Norwich**' project takes into consideration all appraisal and assessment work undertaken to date to arrive at the emerging scheme that is shown to present the best VfM. This takes into account the monetised impacts vs the project costs presented as a Benefit to Cost Ratio (BCR), as well as the findings from any qualitative and non-monetised assessments.

3.13.52 The approach to the assessment of VfM of '**Transforming Norwich**' schemes reflects this by stating that projects scoring a BCR less than 2 may still be considered for funding if they can demonstrate a compelling case for investment based on meeting the objectives of '**Transforming Norwich**'. These include, for example, unlocking barriers to growth, delivering wider economic benefits, environmental and social benefits.

Analysis of Monetised Costs and Benefits

3.13.53 The Benefit to Cost Ratio (BCR) is an indication of the return on public sector investment in a project. The BCR is the ratio of the Present Value of Benefits (PVB) over the Present Value of Costs (PVC), and indicates how much benefit is obtained for each unit of cost. Based on an assessment of the benefits and costs of each option an initial assessment of the '**Transforming Norwich**' project's VfM has been calculated and is presented, that includes an initial BCR (established monetised impacts) and an adjusted BCR (evolving monetised impacts).

Initial Benefit Cost Ratio

3.13.54 Table 59 presents an Analysis of Monetised Costs and Benefits (AMCB) for the '**Transforming Norwich**' low scenario. This informs the initial BCR and is based on the monetised Level 1 transport user benefits.

Table 59: AMCB - Level 1 benefits established monetised impacts for each scenario (£000s. 2010 prices discounted to 2010)

Element	Low Package	Medium Package	High Package
Highway Travel Time Savings	-85,150	-82,485	-82,263
Highway Vehicle Operating Costs	-10,920	-11,371	-11,797
Highway Indirect Tax Revenue	2,551	2,628	2,732
Highway Infrastructure Benefits	39	39	35
Highway Accident Benefits	555	777	966
Highway Local Air Quality Benefits	14	19	23
Highway Noise Benefits	39	51	51
Highway Greenhouse Gas Benefits	-1,161	-1,202	-1,253
Public Transport User Benefits	46,826	56,436	57,212
Public Transport Revenue Benefits	37,614	42,347	42,437
Public Transport Journey Quality Benefits	23,979	22,978	23,456
Private Sector Investment Costs & Developer Contributions	-22,874	-22,879	-35,272
Public Transport Indirect Tax Benefits	-5,955	-6,696	-6,746

Element	Low Package	Medium Package	High Package
Public Transport Decongestion Benefit for Road Traffic	8,517	9,815	9,906
Public Transport Accident Benefits	2,865	3,300	3,331
Public Transport Air Quality Benefits	25	29	29
Public Transport Noise Benefits	152	176	177
Public Transport Greenhouse Gas benefits	150	173	175
Active Mode Benefits	114,735	116,940	127,982
Total PVB	111,962	131,037	131,146
PVC	67,711	84,563	145,871
Initial BCR	1.65	1.55	0.90

Value for Money Statement

3.13.55 The VfM categories defined by the DfT and used by GCP are set out in Table 60.

Table 60: Department for Transport VfM Categories

VfM Category	Implied by…*
Very High	BCR greater than or equal to 4
High	BCR between 2 and 4
Medium	BCR between 1.5 and 2
Low	BCR between 1 and 1.5
Poor	BCR between 0 and 1
Very Poor	BCR less than or equal to 0

Source: Department for Transport Value for Money Framework

3.13.56 The monetised Level 1 economic benefits (based on transport modelling outcomes) show that the low programme produces an initial Benefit to Cost Ratio (BCR) of 1.65 from a PVC of £67.71m (2010 prices, discounted to 2010). According to DfT guidance and criteria the BCR of 1.65 yields medium VfM.

3.13.57 The medium programme produces an initial Benefit to Cost Ratio (BCR) of 1.55 from a PVC of £84.56m (2010 prices, discounted to 2010). According to DfT guidance and criteria the BCR of 1.55 yields medium VfM.

3.13.58 The high programme produces an initial Benefit to Cost Ratio (BCR) of 0.90 from a PVC of £145.87m (2010 prices, discounted to 2010). According to DfT guidance and criteria the BCR of 0.90 yields poor VfM.

3.13.59 The programme creates disbenefits for highway traffic to benefit bus traffic and active modes. Discarding the highway disbenefits, the BCR for the low programme is 3.04, representing high VfM, the BCR for the medium programme is 2.63, representing high VfM, and the BCR for the high programme is 1.53, representing medium VfM.

3.13.60 The approach to the assessment of VfM states that projects scoring a BCR less than 2 may still be considered for funding if they can demonstrate a compelling case for investment. These might include, for example, unlocking barriers to growth, delivering wider economic benefits, environmental and social benefits. As long as the project provides a robust evidence base with a proportionate level of quantitative and qualitative analysis to demonstrate that the project represents good value for money and can meet the policy objectives, these do not need to be included in the central benefit-cost analysis.

3.13.61 In the case of '**Transforming Norwich**' a number of factors justify looking beyond the standard BCR to determine the scheme's VfM, including the importance of the strategic role the programme will play in unlocking and supporting future housing and economic growth, as well as the impacts on improved mobility, mode shift towards public transport and active transport modes and the impact on air quality and greenhouse gases.

3.13.62 In terms of employment impacts under the level 2 benefits, '**Transforming Norwich**' allows an additional 1,683 workers to access jobs in the city centre.

3.13.63 At a Greater Norwich level, the gross economic impacts of the programme calculated from the development dependency benefits are anticipated to be within the range of 1,076 total net jobs, 16,278 housing units and £51.0 million of GVA per annum (once all sites are fully built out).

Appraisal Summary Table

3.13.64 The Appraisal Summary Table (AST) presented is included in Appendix 18 and provides details of the overall impacts of the scheme. These include both qualitative and quantitative benefits.